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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/578,003	05/03/2006	Hideo Nakagawa	071971-0548	5215

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EXAMINER	
WILLIAMS, ALEXANDER O	

ART UNIT	PAPER NUMBER
2826	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/578,003	NAKAGAWA ET AL.	
	Examiner	Art Unit	
	Alexander O. Williams	2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 April 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2 and 4-55* is/are pending in the application.

4a) Of the above claim(s) *2,4,5 and 8-51* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,6,7,54 and 55* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

Serial Number: 10/578003 Attorney's Docket #: 071971-0548
Filing Date: 5/3/2006; claimed foreign priority to 6/3/2004

Applicant: Nakagawa et al.

Examiner: Alexander Williams

Applicant's Amendment filed 4/11/08 to the election of Species II, identifying figures 2a and 2b (claims 1, 3, 6 and 7), filed 10/23/2007, has been acknowledged.

Claims 3, 52 and 53 have been cancelled.

This application contains claims 2, 4, 5 and 8-51 drawn to an invention non-elected without traverse.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. § 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

invention was made to a person having ordinary skill in the art to which said subject matter pertains.

Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 6, 7 and 54 are rejected under 35 U.S.C. § 102(b) as being anticipated by Hattori et al. (Japan Patent Publication # 05-218035).

1. Hattori et al. (figures 1 and 2) specifically figure 1 show a semiconductor device comprising: an insulation film **2** formed on a substrate **1**; a buried metal interconnect **3** formed in the insulation film; and a barrier metal film **4** formed between the insulation film and the metal interconnect, wherein the barrier metal film is a metal compound film **(RuO<SB>2</SB> film 4)**, and wherein the metal compound film contains at least one of elements forming the insulation film and is made of at least one selected from consisting of Ti, Zr, hf, Nb, W, V, Mo, Os, **Rh**, Ir, Pd and Pt or **any alloy thereof.**

6. The semiconductor device of claim 1, Hattori et al. show wherein a metal forming the metal compound film is a refractory metal.

7. The semiconductor device of claim 1, Hattori et al. show wherein the metal interconnect is formed of copper or an copper alloy.

54. The semiconductor device of claim 1, Hattori et al. show wherein the insulation film is SiO2.

Claims 1, 6, 7, 54 and 55 are rejected under 35 U.S.C. § 102(e) as being anticipated by Shimizu et al. (U.S. Patent Application Publication # 2007/0252280 A1).

1. Shimizu et al. (figures 1 to 8) specifically figure 1 show a semiconductor device comprising: an insulation film **10,8,4** formed on a substrate **1**; a buried metal interconnect **12a** formed in the insulation film; and a barrier metal film **10a** formed between the insulation film and the metal interconnect, wherein the barrier metal film is a metal compound film, and wherein the metal compound film contains at least one of elements forming the insulation film and is made of at least one selected from consisting of **Ti**, Zr, hf, Nb, W, V, Mo, Os, Rh, Ir, Pd and Pt or any alloy thereof.

6. The semiconductor device of claim 1, Shimizu et al. show wherein a metal forming the metal compound film is a refractory metal.

7. The semiconductor device of claim 1, Shimizu et al. show wherein the metal interconnect is formed of copper or an copper alloy.

54. The semiconductor device of claim 1, Shimizu et al. show wherein the insulation film **4** is SiO2.

55. The semiconductor device of claim 1, Shimizu et al. show wherein the insulation film **4** is nitride.

[0033] A first interlayer insulating film 4 of silicon oxide (SiO.sub.2) is formed on the semiconductor substrate 1, covering the MOS transistor 3. Contact holes 4a and 4b are formed through the first interlayer insulating film 4 in the areas corresponding to the impurity doped regions 3c and 3d. Conductive plugs 5a and 5b are buried in the contact holes 4a and 4b. Each of the plugs 5a and 5b is constituted of a barrier metal layer of titanium nitride (TiN) covering the sidewall and bottom of the plug and a tungsten member formed on the barrier metal layer.

[0038] Each of the wiring patterns 12a and 12b has a three-layer structure made of a barrier metal layer covering the side wall and bottom of the wiring trench 10a, 10b, a seed layer covering the surface of the barrier metal layer, and a main wiring material member filled in the wiring trench and covering the seed layer. The barrier metal layer is made of tantalum (Ta), tantalum nitride (TaN), titanium nitride (TiN) or the like. The barrier metal layer may have a lamination structure of a Ta layer and a TaN layer. The seed layer and main wiring material member are made of copper or alloy containing copper as its main composition.

Claims 1, 6, 7, 54 and 55 are rejected under 35 U.S.C. § 102(b) as being anticipated by Ito et al. (U.S. Patent Application Publication # 2003/0116854 A1).

1. Ito et al. (figures 1 to 13E) specifically figure 2 show a semiconductor device comprising: an insulation film **11a** formed on a substrate **24**; a buried metal interconnect **12** formed in the insulation film; and a barrier metal film **18** formed between the insulation film and the metal interconnect, wherein the barrier metal film is a metal compound film, and wherein the metal compound film contains at least one of elements forming the insulation film and is made of at least one selected from consisting of **Ti**, Zr, hf, **Nb**, W, V, Mo, Os, Rh, Ir, Pd and Pt or any alloy thereof.

6. The semiconductor device of claim 1, Ito et al. show wherein a metal forming the metal compound film is a refractory metal.

7. The semiconductor device of claim 1, Ito et al. show wherein the metal interconnect is formed of copper or an copper alloy.

54. The semiconductor device of claim 1, Shimizu et al. show wherein the insulation film **11a** is SiO2.

55. The semiconductor device of claim 1, Shimizu et al. show wherein the insulation film **11a** is nitride.

[0048] In the semiconductor device shown in FIG. 2, an insulation layer 11 is formed on a semiconductor substrate 24, and a lower wiring layer 12 is buried in the insulation layer 11 with a barrier metal layer 18 interposed therebetween. The insulation layer 11 has a laminated structure of a low dielectric constant insulation film 11a as will be described below and a high strength insulation film 11b having a high fracture strength and serving as a cap layer, such as a silicon oxide film, a silicon nitride film and a silicon carbide film. However, the insulation layer 11 can be formed of a single layer. A silicon nitride film 13 (whose relative dielectric constant is 7.0 and Young's modulus is 100 GPa) acting as an etching stopper layer is formed on the insulation layer 11 and a low dielectric constant insulation film 14 is formed on the silicon nitride film 13. The film 14 can be made of, for example, SiO(CH.sub.3).sub.x (whose relative dielectric constant is 2.5 and Young's modulus is 10 GPa or lower). The film 14 can also be made of hydrogen silsesquioxane, a carbon-contained SiO.sub.2 film (SiOC), a porous silica film, a polymer film, an (fluorine-doped) amorphous carbon film, or the like. The Young's modulus of these materials is about 10 GPa or lower.

[0049] An upper wiring layer 19b is buried in the low dielectric constant insulation film 14 and connected to the lower wiring layer 12 through a plug 19a. The upper wiring layer 19b and plug 19a have a barrier metal layer 18 on their surfaces. The barrier metal layer 18 can be made of Ta, Ti, Nb, an alloy containing the elements, a compound of the elements, or a laminated film of the elements. The conductive layer 19 such as the upper wiring layer 19b and plug 19a can be formed of Cu, Al, or an alloy containing these elements.

[0050] A high Young's modulus insulation film 16 whose Young's modulus is 15 GPa or higher is formed between the barrier metal layer 18 formed on the side of the plug 19a and the low dielectric constant interlayer insulation film 14. The insulation film 16 can be formed of a silicon oxide (SiO) film (whose relative dielectric constant is 4.0 and Young's modulus is 60 GPa), a silicon nitride (SiN) film (whose relative dielectric constant is 7.0 and Young's modulus is 100 GPa), or the like. The film 16 can also be formed of a silicon

oxynitride (SiON) film (whose relative dielectric constant is 4.0 to 5.0 and Young's modulus is 80 GPa to 100 GPa), a silicon carbonitride (SiCN) film (whose relative dielectric constant is 4.0 to 5.0 and Young's modulus is 100 GPa).

Response

Applicant's arguments filed 4/11/08 have been fully considered, but are moot in view of the new grounds of rejections detailed above.

The insertion of Applicant's additional claimed language, for example, "in claims 1 and new claims 54 and 55" cause for further search and consideration to make this action final.

Applicant's amendment necessitated the new grounds of rejection. Accordingly, **THIS ACTION IS MADE FINAL**. See M.P.E.P. ∋ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 C.F.R. ∋ 1.136(a).

A SHORTENED STATUTORY PERIOD FOR RESPONSE TO THIS FINAL ACTION IS SET TO EXPIRE THREE MONTHS FROM THE DATE OF THIS ACTION. IN THE EVENT A FIRST RESPONSE IS FILED WITHIN TWO MONTHS OF THE MAILING DATE OF THIS FINAL ACTION AND THE ADVISORY ACTION IS NOT MAILED UNTIL AFTER THE END OF THE THREE-MONTH SHORTENED STATUTORY PERIOD, THEN THE SHORTENED STATUTORY PERIOD WILL EXPIRE ON THE DATE THE ADVISORY ACTION IS MAILED, AND ANY EXTENSION FEE PURSUANT TO 37 C.F.R. ∋ 1.136(a) WILL BE CALCULATED FROM THE MAILING DATE OF THE ADVISORY ACTION. IN NO EVENT WILL THE STATUTORY PERIOD FOR RESPONSE EXPIRE LATER THAN SIX MONTHS FROM THE DATE OF THIS FINAL ACTION.

The listed references are cited as of interest to this application, but not applied at this time.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alexander O. Williams whose telephone number is (571) 272 1924. The examiner can normally be reached on M-F 6:30AM-7:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Sue Purvis can be reached on (571) 272 1236. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Alexander O Williams/
Primary Examiner, Art Unit 2826

AOW
7/15/2008